Techno-economic Analysis of a Dynamic Impairment-Aware Optical Network

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In planning or upgrading a long haul optical core network it is important to optimize investments by balancing the cost and frequency of equipment installations. Optical networks send information over optical fiber using many millions of short laser pulses per second. The major cost factor in an optical core network is the equipment which performs the aggregation of packets at the edge and the conversion between electronics or and optics for switching. We can switch the traffic in the optical domain, e.g. by using miniature mirrors (this technology is called MEMS), reducing the need for electronics in these switches. In addition to enabling transparency, optical switches can have the flexibility to support fast changing traffic in a cost-effective manner, which means that operators do not have to over-provision their network with equipment meant to serve future variations in traffic.

One issue in optical networking is the accumulation of various impairments which gradually make the signal less clear as it travels along the optical fiber and passes through various equipment along the way (e.g. amplifiers and switches). In order to cope with these impairments beyond the capabilities of manufacturers to specify safe margins of operation, an Impairment Aware control plane has been proposed in the literature. This means that the network assigns resources to each optical path by calculating the effects on-the-fly and choosing the connection with the best quality.

To assess impairment aware network planning, we dimension a reference network, comprising of 14 switches interconnected by 23 links. The switches can be one of 3 different architectures currently proposed in the literature, all based on the same technology. The solution is compared to a method without any impairment considerations.

Our research shows that the impairment awareness can decrease the amount of investments needed in planning the network, and also reduces the operational costs of the network.

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